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Intelligent RFID – Identification and beyond

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Abstract
Intelligent RFID systems are finding increasing usage in today's systems. Innovation possibilities are emerging from the development of RFID, wireless communications networks, and information and communications systems. In the future, systems with automated control abilities will be realised with help from this technology. The development of the RFID market and innovative applications of intelligent RFIDs will lead to more systems deployments.

Introduction

Radio Frequency Identification Devices (RFIDs) have been deployed in many payment and monitoring systems. Conventional identification systems, like barcodes, are being replaced by RFIDs. The technology is a non-contact method that has a higher speed of identification and does not require an exact position of the object in comparison to traditional technologies. RFIDs may also include the use of memory in the transponder (with read/write capabilities) and the simultaneous reading of multiple tags. Information can then be administered and stored directly on the transported object which would lead to automatisation possibilities through the whole value added chain. Distribution is decentralized and no longer coupled to merchandise management or inventory control.

Business Case and Development of the Market

Chip cards for entrance control, telephone cards, or bank cards are used on a daily basis by most everyone. Many of these systems use contact or magnetic readers. Wireless readers in the electromagnetic near-field are much quicker, since the card doesn't have to be inserted into a slot, rather it only needs to be in the vicinity of the reader. Most of us already have a pay-card in our pockets for lunch in the cafeteria or for riding on the bus. A further application is in the identification of goods in logistics but these applications are not so visible in our daily life since they are confined to the transportation industry. In a few years time, identification tags will be common in retail stores.

These applications demand large quantities of RFID devices. RFID chips are going to set new records in the Silicon chip market. The market growth is shown in Figure 1.

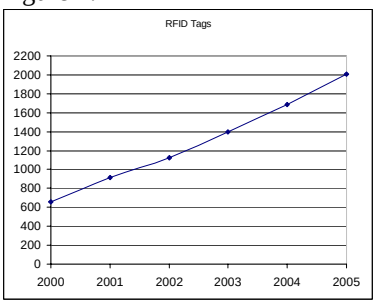

Figure 1: World market for RFID Systems in Mio $ [Fin02]

Sales in 2005 are projected to top $2 billion. The most important application is in transport monitoring with almost $500 Mio. This is followed by security and access control and by supply chain management. Other important areas of adoption are asset management, toll collection, and automotive immobilizers.

Example Application

An example for a RFID application from the company Schoeller and Wilms (EUR04) is in the administration of pallets for inventory control. The system was configured with tags that are detected by readers. These tags are, for example, integrated into delivery ramps. When the pallets are loaded they are analysed and the delivery trucks are routed to the appropriate customer. This system not only allows the inventory to be controlled, but also static analysis and the optimisation of capacity. In the near future, the system will also be expanded and used for the planning and control of repairs.

Example for the Combination of Sensor and RFID Technology

A temperature data logger in the form of a chip card is being manufactured by the firm KSW Mikrotec [RFI04]. The card is made of a flexible foil that can be adhesively bonded to a carton. The system registers the temperature during transport or storage and the transport history can then be read out by means of a 13.56Mhz RFID-Reader. In this way a breach of the specification can be detected during transport before the goods are unloaded. The system currently costs $25, however a price of $2,5 is expected with growing market and even $1 seems to be feasible. Energy usage with such systems is the key question. The data logger function requires relatively little power and is energised through a battery. Energy for the data transfer is extracted from the EM field of the RFID-reader. This combination of energy transfer from the electromagnetic field of the reader and the autonomous operation from a support battery is likely to be the solution to many RFID-systems.

One problem, that is currently being examined by many research groups world wide is the monitoring of containers.

Intelligent RFID systems should monitor the critical parameters during transport. However, this doesn't required that the RFID system be outfitted with sensors. It could also be a sensor system that is already in the container or on the goods that is wirelessly queried. A measurement system that transmits air pressure, humidity, and temperature is being developed by the Georgia Institute of Technology [RFI04-2].

In the future, a completely automated system that controls the transport process is imaginable. The container could sense the individual goods that are loaded, for example, sacks that contain coffee. From the internet or through a database it loads information for the temperature and air humidity boundaries. It then polls for sensors, to see what is available and constructs an Ad-hoc network tailored to monitor the coffee (see Figure 2).

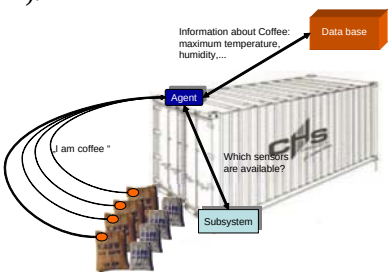

Figure 2: Monitoring of Containers with Sensor Technology

Not only can the system measure and save values, it can comprehend critical situations. For example, it could notify "turne on humidifier" when the humidity drops below a critical level. It could also intervene and redirect the containers in real time. The autonomy of the logistic goods (such as cargo, loading equipment, and transport systems) is made possible through new information and communication technology, such as RFID and other technological developments (compare to Figure 3).

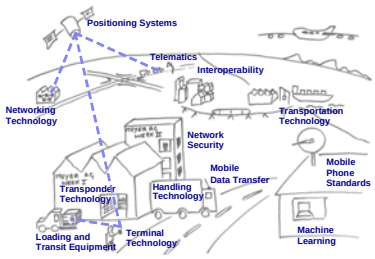

Figure 3*: Technological Trends*

This enables and demands new control strategies and autonomous, decentralised control systems for logistical processes. Advanced systems of this kind are investigated at the University of Bremen through the Collaborative Research Area "Autonomous Cooperating Logistic Processes: A Paradigm Shift and its Limitations" (SFB 637) [SFB04] which is funded by the German Research Foundation (DFG).

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